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(58) Field of Search

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(54) Abstract Title

Controlling an electronic device by detecting a handheld member with a camera

(57) A means for controlling an electronic device 1 comprises a control member 4 adapted to be held in a users hand and moved in space. The control member 4 has at least one characteristic such as the shape of spokes 8,9,10,11 or coloured marks such as circle, square, cross and triangle 12,13,14,15 enabling its position and orientation in space to be determined. A camera means 5 detects the position of the control member 4 with respect to time and an analysing means 6 analyses the positional information to ascertain the movement of the control member 4. Control signal generating means 7 generates signals for the electronic device 1 in response to the analysed movement of the control member 4. The camera means may be a stereoscopic array of pinhole cameras, or a single camera; the member 4 may have a ring (23, fig 4) connecting the spokes; while the analysing means 6 may be hardware or software. Comparison with a reference image of the control member may be made. The means may join to a games console (1, fig 3) in place of a conventional joystick or keypad, or the camera means may be integral to the console.

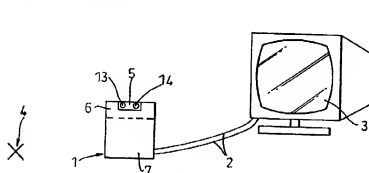


Fig. 1

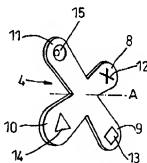


Fig. 2

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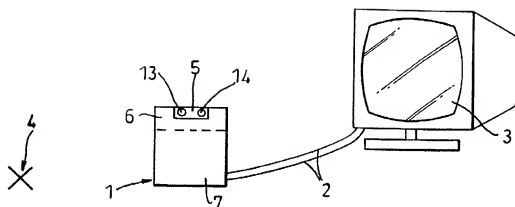


Fig. 1

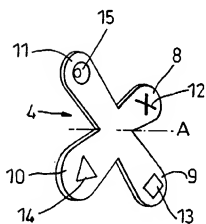


Fig. 2

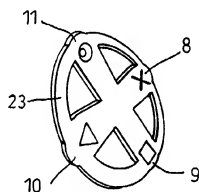


Fig. 4

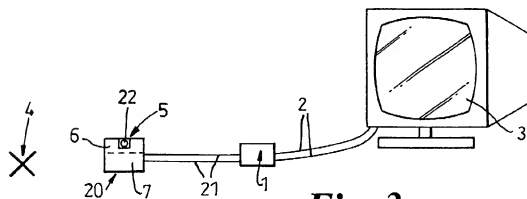


Fig. 3

CONTROLLING ELECTRONIC DEVICES

This invention relates to means for controlling electronic devices such as games consoles or the like.

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Conventionally such electronic devices are controlled by a joystick or keypad, usually integrated into the device. The device may have an integrated display screen, or be connected to a separate display monitor, which displays the game being played. Movement of the joystick or depression of buttons on the keypad sends control signals to the device. One disadvantage of the joystick and the keypad is that they may not be easy to use, especially for users with disabilities affecting the fine motor control of the hands.

15 According to the present invention, a means for controlling an electronic device comprises a control member adapted to be held and moved in space by a user, and having at least one characteristic enabling its orientation in space to be determined, a camera means for detecting the position of the control member with respect to time, means for analysing
20 the positional information to ascertain movement of the control member, and means for generating control signals for the electronic device in response to the movement of the control member.

The position of the control member at any point in time is detected by the
25 camera means. The orienting characteristic on the control member means that movement can be deduced from the positional information and translated into control signals for the device. The control member has a greater freedom of movement than the normal joystick or keypad. For example, it can be moved bodily in space up or down, side to side, and
30 towards or away from the camera means. It can also be rotated. Each of these movements can be detected and used to generate control signals for

the device. Where the device is a games console, different movements can be used to move a character and perform other functions such as selecting a mode of firing a weapon. The control member is easy to use, as it does not rely significantly on fine motor control.

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The control member may comprise at least two spokes radiating from a central axis, with at least one spoke having an orienting characteristic. Preferably four spokes are provided, although there could be as many as eight.

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The orienting characteristic is preferably provided on the outer end of at least one spoke. Preferably, the orienting characteristic comprises at least one distinguishing shape or mark. Each orienting characteristic may comprise a mark such as a cross, circle, triangle or square. The orienting characteristic may be the shape of the spoke. For example, one spoke could be longer than the rest, or of a different outline. Different colours may also be used as well as other distinctions.

15

The outer ends of the spokes may be joined by a ring. The control member may also include a handle on its rear side.

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The preferred control member with four spokes enables rotation of the control member about the central axis (i.e. in the plane of the spokes) to be detected, as well as inclination of the spokes to the plane.

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Conveniently, the analysing means use algorithms to deduce the movement of the control member from the positional information acquired by the camera means. The analysing means may be executed as software, or hardware such as microprocessors.

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The signal generating means uses the movements analysed by the analysing means to generate appropriate control signals for operating the device. The generating means is preferably executed as software. It may generate signals which emulate those of existing game consoles, enabling
5 the control member to be used with existing game consoles.

The camera means preferably comprises a stereoscopic camera array, having a pair of pinhole cameras whose optical properties are known. The images from the two cameras are combined to provide an accurate
10 representation of the position of the control member in space, so that its movement can also be accurately analysed.

Alternatively, one camera may be used. Again, its optical properties are known. With one camera, movement towards and away from the camera
15 is more difficult to analyse than with two. However, large movements towards or away from the camera can be detected, by looking at the change in surface area, and comparing the current dimensions of the control member with those for a given distance from the camera, which will be known. The other movements (up or down, side to side, rotation
20 and inclination) can be determined accurately by comparing the camera image with an ideal image of the control member at a fixed position.

Preferably, the analysing means stores the size and shape of the control member. This enables more accurate analysis of the movement of the
25 control member to be made. The camera image can be compared with the stored ideal image to determine the location and orientation of the control member.

The camera means and the analysing and generating means are preferably
30 combined into a single unit. This may be integrated into a games

console. The camera means and the analysing and generating means may be separate and adapted to be joined to a console by appropriate leads.

Various embodiments of the invention are illustrated, by way of example only, in the accompanying drawings in which:

Figure 1 is a schematic illustration of a control means for an electronic device;

Figure 2 shows the control member in detail;

Figure 3 is similar to Figure 1, but shows a modification; and

Figure 4 shows a modified control member.

Figure 1 shows a schematic view of a means for controlling an electronic device such as a games console 1. The games console 1 is connected by appropriate leads 2 to a monitor 3 on which the game being played is displayed.

The control means has a control member 4 which is held and moved in space by a user (not shown) and has characteristics enabling its orientation in space to be determined. A camera means 5 detects the position of the control member 4 over time, analysing means 6 analyses the positional information to ascertain the movement of the control member 4, and generating means 7 generates control signals for the device 1 in response to movement of the control member 4.

The control member 4 is shown in more detail in Figure 2. It comprises a plastics member having four spokes 8, 9, 10, 11 radiating in a cross-shape from a central axis A. Each spoke has on its respective outer end

of its front face an orienting characteristic 12, 14, 14, 15. The orienting characteristics are a different colour from the spokes, and each has a different shape. In this case they are a cross, a square, a triangle, and a circle, but it will be appreciated that any suitable shapes could be used.

- 5 The control member 4 also has on its rear face a handle (not shown) by which it can be held by the user.

The control member 4 can be moved bodily in space, and relative to the camera means 5, in the following ways: up or down, side to side, and
10 towards or away from the camera means 5. In addition, it can be rotated about its central axis A (in the plane of the spokes 8, 9, 10, 11) or inclined to that plane.

The camera means 5 detects the position of the control member 4 as it is
15 moved. The camera means 5 is mounted on the console 1, and comprises a stereoscopic camera array of two pinhole cameras 13,14 whose optical properties are known. The images from the cameras 13, 14 are analysed by the analysing means 6, to ascertain the movements of the control member 4.

20

The analysing means 6 is integrated into the console 1 and is executed as hardware, such as a microprocessor, although it may be provided as software. The analysing means 6 receives the images from the cameras 13, 14, and processes these to determine the position and orientation of
25 the control member 4 at any given time. The use of the stereoscope camera array means that the location of the control member 4 in space can be determined absolutely. The analysing means 6 uses suitable algorithms to process the images, and holds an ideal image of the control member 4 at a given distance from the camera means 5 and with a given
30 orientation, to assist in the processing. Comparison of one set of images with the previous one is used to determine movement. Thus, changes in

the position of the orienting characteristics in the plane of the spokes are used to determine the up or down and side to side movement of the control member 4, while changes in their size are used to determine the towards and away movement. Angular movement of at least two of the orienting characteristics is used to determine rotation, and changes in their shape determine inclination.

The movement ascertained by the analysing means 6 is used by the generated means 7 to provide control signals for the console 1. The generating means 7 is integrated into the console 1, and is executed as software. The generating means 7 assigns each movement (as described above) a particular command to the games console 1 – for example movement of a character in the game, selection of a mode or the firing of a weapon. The ability to rotate the control member 4 is particularly useful when the game simulates the driving of a vehicle.

Thus, simple movements of the control member 4 can be used to send control signals to the games console 1, ensuring ease of use.

Figure 3 shows a modification, where the games console 1 is separate from the control unit 20. In Figure 3 the camera means 5, analysing means 6 and generating means 7 are all housed in the control unit 20, which is connectable to the games console 1 by appropriate controller leads 21. The generating means 7 are arranged to generate control signals which emulate those of an existing game controller (not shown), such as a joystick or keypad.

Further, in Figure 3 the camera means 5 comprises a single camera 22. This, naturally, does not provide as much information as the pair of cameras 13, 14 of Figure 1, as the position in the towards and away from camera direction is more difficult to detect. However, the camera image

can be compared with the ideal image, and the difference in the surface area and size will give a good approximation of towards / away from distance. The other movements can be determined accurately by comparison with the ideal image, and comparison of one camera image with a previous one. Otherwise, the embodiment of Figure 3 is the same as that of Figure 1.

Figure 4 shows another embodiment of the control member 4, in which a ring 23 connects the outer ends of the spokes 8, 9, 10, 11. Otherwise the member 4 of Figure 4 is the same as that of Figure 2, and corresponding reference numerals have been applied to corresponding parts. The ring 23 has advantages as it provides a further comparison item for processing of the image.

It will be appreciated that the control member 4 could be modified in other ways (not shown). For example, only one spoke need have the orienting characteristic, but more orienting characteristics increases accuracy. Alternatively, the spokes could be of different shapes, so that the shape provides the orienting characteristic. While the control members 4 shown have four spokes, any number from two to eight would be possible. Whatever the size and shape of the control member 4, its dimensions must be held in the analysing means 6 to enable the analysis of its movements to be made.

CLAIMS

1. A means for controlling an electronic device comprises a control member adapted to be held and moved in space by a user, and having at least one characteristic enabling its orientation in space to be determined, a camera means for detecting the position of the control member with respect to time, means for analysing the positional information to ascertain movement of the control member, and means for generating control signals for the electronic device in response to the movement of the control member.
2. A means for controlling an electronic device as claimed in claim 1, in which the control member comprises at least two spokes radiating from a central axis with at least one spoke having an orienting characteristic.
3. A means for controlling an electronic device as claimed in claim 2, in which the control member comprises four spokes radiating from a central axis with at least one spoke having an orienting characteristic.
4. A means for controlling an electronic device as claimed in claim 2 or claim 3, in which the orienting characteristic of the control member is located at an outer end of at least one spoke.
5. A means for controlling an electronic device as claimed in any preceding claim, in which the orienting characteristic of the control member is at least one distinguishing shape or mark.
6. A means for controlling an electronic device as claimed in claim 2 or claim 3, in which the orienting characteristic of the control member is the shape or size of at least one spoke.

7. A means for controlling an electronic device as claimed in any of claims 1 to 3, in which the orienting characteristic is the colouring of the control member.
- 5 8. A means for controlling an electronic device as claimed in any of claims 2 to 7, in which the spokes of the control member are joined by a ring.
9. A means for controlling an electronic device as claimed in any
10 preceding claim, in which a handle is provided on the rear side of the control member.
10. A means for controlling an electronic device as claimed in any preceding claim, in which the analysing means uses algorithms to deduce
15 the movement of the control member from the positional information acquired by the camera means.
11. A means for controlling an electronic device as claimed in any preceding claim, in which the analysing means is executed as software.
20
12. A means for controlling an electronic device as claimed in any preceding claim, in which the analysing means is executed as hardware.
13. A means for controlling an electronic device as claimed in any
25 preceding claim, in which the signal generating means uses the movements analysed by the analysing means to generate appropriate control signals for operating the electronic device.
14. A means for controlling an electronic device as claimed in claim 13,
30 in which the control signal generating means is executed as software.

15. A means for controlling an electronic device as claimed in any preceding claim, in which the camera means comprises a stereoscopic camera array, having a pair of pinhole cameras whose optical properties are known.

5

16. A means for controlling an electronic device as claimed in any preceding claim, in which the camera means comprises a single camera whose optical properties are known.

17. A means for controlling an electronic device as claimed in any preceding claim, in which the analysing means stores the size and shape of the control member.

18. A means for controlling an electronic device as claimed in any preceding claim, in which the camera means and the analysing and generating means are combined into a single unit and integrated into a games console.

19. A means for controlling an electronic device as claimed in any preceding claim, in which the camera means and the analysing and generating means are separate and adapted to be joined to a games console by appropriate leads.

20. A means for controlling an electronic device substantially as described herein with reference to and as illustrated in Figures 1 to 4 of the drawings.

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 Claims searched: 1 at least

Examiner: Terence Newhouse
 Date of search: 8 November 2002

Patents Act 1977 Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK CI (Ed.T): F2Y(YTA)

Int CI (Ed.7): G06F 3/00 3/033; G06K 11/08 11/18

Other: ONLINE: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	EP 1074934 A2 (Lucent), see whole document	1,5,9-11, 13,14,16
X	EP 0716389 A1 (IBM), see whole document	1,2,4,5, 10,11, 13,14,16
A	US 20020126090 (IBM), see for example paragraph 0011	
X,P	US 20020036617 (Pryor), see for example embodiments of figures 4,5a,5b,5c,8a,8c,14,15,18,19,21 & 23	1,5,7,10, 11,13,14, 16,19
X	US 6243491 B1 (Lucent), see whole document	1,5,7,10, 12,13, 16,19
X	US 5297061 (Univ. of Maryland), see whole document	1,2,4, 8-11,13, 14,16
X	US 5227985 (Univ. of Maryland), see whole document, for example column 1 lines 32-68	1-4,10,11 13-16

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.